Intermittent Upward Fixation of Patella in the Horse:

Part I: A Literature Review

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Introduction:

The stifle is the largest, most complex joint in the horse, and problematically the weakest. Anatomically this joint corresponds to the knee joint in humans. For treatment of the human knee in physical therapy it is well established that the quadriceps muscle plays a pivotal role in the alignment of the patella for proper knee function. The same is true of the horse. Results can be devastating for the stifle when quadricep function declines due to lack of activity, growth spurts, or injury. This leads to stifle pathomechanics of the patella getting "stuck" on a bony protrusion of the femur, resulting in debilitating pain, swelling, and reduction in functional locomotion. A common malady of the equine stifle is of upward fixation of the patella (UFP): The animal can not relieve this fixation through contraction of its quadriceps muscles[1]. The patella lodges on a medial aspect of the femoral condyle causing a complete fixation, debilitating the horse from moving its leg forward. Intermittent upward fixation of the patella (IUFP) is a common dysfunction of the patella intermittently slipping in and out of this fixed position causing repeated trauma to the involved ligament and retro-patellar articular surface. Historically various invasive surgical procedures and a multitude of suggestions for conditioning exercise have had less than favorable results. Until the recent decade not much has been offered to the equine in the way of rehabilitation for this scenario.

Incidence:

Upward fixation of the patella has been reported to occur in all breeds of horses, especially in young horses, either prior to, or just beginning training. The significance is higher in breeds of Miniature Horses, Shetlands, riding ponies and Standardbreds[2,3]. UFP is common with fit horses that are stall rested for extended amounts of time, which lose muscle tone from inactivity. Dumoulin, et al, reported that UFP occurred in roughly 0.9% of their reference population of 8,495 with 78 horses affected[3]. UFP is often bilateral and may affect one limb more than the other [2]. Twenty-three of Dumoulin's study had bilateral involvement, while 55 horses showed unilateral UFP, with out side preference[3]. The median age was 3 years, with the median onset age at 1.5 years. Fifteen percent of all mares in this study started to exhibit signs of UFP or worsened at the completion of gestation. It is not known whether this occurs because of increased stress on joint structures, deconditioning, or hormonally influenced ligament laxity. Sixteen percent of these horses have close relatives with signs of UFP, supporting the suggestion that the condition may be familial, due to a strong inheritance of body type. Sex predisposition for UFP was not determined[3].

Functional Anatomy**:**

The stifle is the largest of all joints in the equine and has the most elaborate of all the articulations[1]. The stifle is also known as the tibial femoral joint in the horse. Due to anatomical structure of the stifle, and its location, it is the weakest joint of the horse[1]. The **stifle joint** is made up of four bones the femur, the tibia, the patella and a remnant fibula. The fibula is a non-functional bone that is fused onto the tibia. The **patella, a sesamoid bone**, submerged with in the quadriceps tendon, functioning as a pulley, similar as in the human knee and quadriceps. The patella's smooth movement depends upon the normal function and strength of the quadriceps muscles the tensor fascia latae and biceps femoris[4]. There are three joints with in the stifle: medial femoropatellar, the lateral femorotibial, the medial femorotibial. Each of these joints has its own joint capsule.

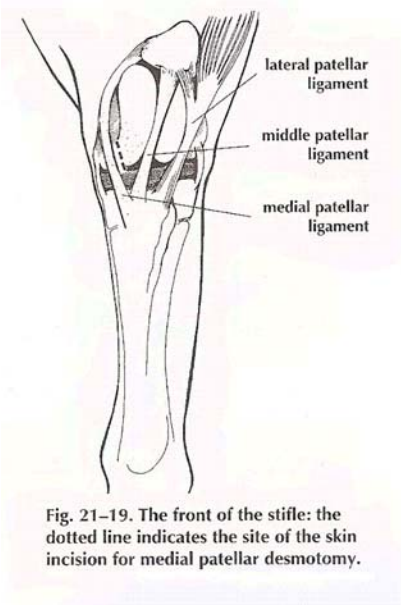

Fig. 21–19. The front of the stifle: the dotted line indicates the site of the skin incision for medial patellar desmotomy.

Schematic taken from Lameness, King, C. p887, 1997

In the static standing position, the equine patella is located above the femoral trochlea. The patella is supported by three ligaments, the medial, middle and lateral ligaments. These **three patellar ligaments** act as the functional insertions of the quadriceps femoris and biceps femoris muscles in attaching the patella to the tuberosity of the tibia[2]. The **medial patellar ligament (MPL)** with its parapatellar fibrocartilage the medial ridge hooks over the medial femoral condyle[2].The femoral condyle provides a fibrocartilagenous extension creating a seat like formation for the patella when it is in the locked position. This unique locking mechanism in the extended stifle allows the horse to stand for prolonged periods. This mechanism allows horses to sleep in the standing position, utilizing minimal muscle recruitment. The MPL is the weakest of the three ligaments[1]. It is longer than the other ligaments and runs in an oblique distolateral direction, with it origin on the parapatellar fibrocartilage and insertion on the craniomedial aspect of the tibial tuberosity. The caudal margin of this ligament is confluent with the common aponeurosis of the sartorius and gracilis muscles, where as the proximal part furnishes the insertion to portions of the vastus medialis muscle[2].

On the medial side of the stifle, several key muscles are attached to or around the stifle and patella. The **gracilis** muscle covers a high percentage of the medial portion of the thigh, inserting on the medial patellar ligament. It solely functions as an adductor[1]. The **sartorius** arises from the iliac fascia and psoas tendon to insert on the medial patellar ligament and tuberosity of the tibia. It flexes and abducts the hip. The **adductor muscle** inserts on the medial epicondyle of the femur which includes the collateral medial ligament of the stifle joint[1].

The muscles attaching on the **lateral aspect** of the stifle and patella are the following: tensor fascia latae, quadriceps femoris and biceps femoris. The **tensor fascia latae** runs superiorly from the tuber coxae (ASIS in humans) and the superficial gluteal

muscle over the coxofemoral joint down into a broad aponeurosis encompassing the patella and attaches to the lateral boarder of the lateral patellar ligament. Its function is to flex and abduct of the hip and extends the stifle[1]. It intertwines and over lays the ever dominant **quadriceps musculature** with other muscles such as the more lateral **superficial gluteal muscles** and the **bicep femoris**. Both the cranial and middle divisions of the **bicep femoris** insert on the lateral patellar boarder and the lateral patellar ligament respectively[6].

Lying deep within the anterior hip musculature the anterior muscle group is comprised of the **quadriceps femoris** and the **iliocapsularis**. Q**uadriceps femoris** covers the cranial and craniolateral surfaces of the femur. It is comprised of four individually named heads of origin, one of which arises from the ilium, just cranial to the coxofemoral joint, while the other three arise from the femur. All four components insert on the patella. **Rectus femoris** inserts on the base and anterior surface of the patella. **Vastus medialis** inserts on the medial boarder of the pateall and the proximal portion of the medial patella ligament. **Vastus lateralis** inserts on the lateral and anterior surfaces of the patella. Vastus intermedius inserts on the base of the patella and the femoropatellar joint capsule[1]. All these tendons of the **quadriceps muscles** culminate attaching at the patellar deep aponeurosis on to the patella. When they contract, they extend (straighten) the stifle[5,1]. While vastus intermedius helps raise the femoropatellar capsule during the extension of the stifle joint, the rectus femoris helps in the flexion of the hip joint. The iliocapsularis works in conjunction with vastus intermedius, with the sole function of raising the joint capsule during flexion of the joint[1]. The anterior aspect of the patella and stifle are covered by superficial fascia.

The muscles that support and connect to the stifle joint play a vital role of health and function of the patella. They keep it tracking optimally for the greatest functional performance of the joint, contributing to the power of the “hind end engine”. If the muscles previously described have adequate force and the timing, the contraction is adequate, and there are no other conformational, ligament or joint pathology involved, than chances of the patella getting hung up for a fixed period, or intermittently, is significantly reduced. Maintenance or conditioning of these muscles is important. The before mentioned muscles have a direct attachment and therefore direct affect on the patella and stifle joint of the horse. There are many other muscles that play a significant role in flexion and extension of the joints of the hip, stifle and lower leg, with multiple actions played by each, but their significance is beyond the purpose of this case study.

The lateral cutaneous **femoral nerve (L3, 4)** supplies the cutaneous innervation for the stifle joint[6]. The femoral nerve passes through the rectus femoris and medialis respectively of the quadriceps femoris. The extensor action of the quadriceps on the stifle is essential to the support and extension of the limb. If the femoral nerve is damaged the extensor action at the stifle is lost and the limb collapses[6].

Pathomechanics of IUFP:

IUFP and UFP occur when the patella fails to disengage from the medial trochlear ridge of the femur due to ineffective contraction of the stifle extensor mechanism at initiation of attempted limb flexion just seconds before the motor command for the horse to take a step forward with the rear leg. Failure of this mechanism to release the patella with in the joint, causes the stifle to become fixed in extension, disallowing the lower leg to move into elevated flexion, therefore dragging the hoof and toe along the ground as the horse attempts to move forward as seen in this schematic .

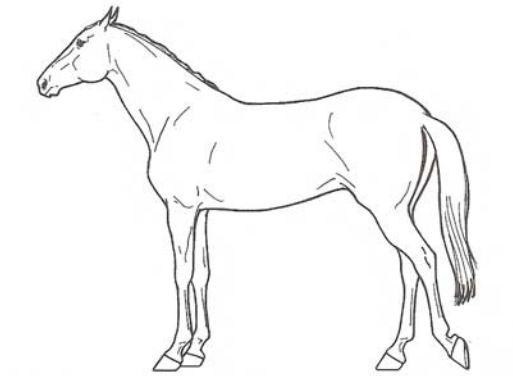

Fig. 21–18. In severe cases of upward fixation of the patella, the horse's leg is extended behind it, and the horse cannot bring it back into the normal position.

Schematic taken from Lameness, King, C. pg 885, 1997.

Flexion of the leg is not possible until the patella returns to the intertrochlear groove which is then followed by limb hyper flexion[1]. This is a dangerous situation for both horse and rider if the horse is being ridden. IUFP is when the patella releases spontaneously, but locks again in variable intervals in forward movement (gaits) of the horse.

Contributing Factors:

Several factors of pathogenesis come into play contributing to IUFP. Most common is the **anatomical design (**conformation**,** similar to posture in humans**)** of the horse's hind leg. Ideally the articular angle of the stifle joint should be about 150 degrees[1]. A leg with decreased angulations formed by the interplay of joints of the pelvis, hip, stifle and hock (excessively straight hind limb) is more prone to stifle problems. This can be due to heredity (genetics) or breed dominant traits. A horse that has **low muscle tone** from poor conditioning with low activity level is prone to IUFP. The timing and strength of the muscle contractions is vital, hence the relative tone or laxity of the muscle controls or doesn't , patella motion and the medial ligament stays locked around or "hung up" on the medial femoral condyle. An injury to the stifle, associated musculature or pelvis, combined with **prolonged stall rest**, may contribute to muscle atrophy and the development of IUFP. In very fit horses it has been noted that with one week of stall confinement, horse's stifles may begin to lock[5]. **Muscle and neurological conditions** such as spasticity, muscle spasm, myopathies, hypertoncity of the quadriceps, along with poor neuromotor coordination between flexors and extensors may cause IUFP. **Abnormal tension** of the patellar ligaments and abnormal conformation of the fibrocartitlage of the pateall or proximal medial trhochlear ridge can cause IUFP [3]. Medial ligament pathology or desmitis may be the cause or effect of IUFP. **Excessive training** that places excessive stress on the joint such as in Standardbred racing in one direction on steeply banked tracks can cause excessive force on the stifle[1]. Abnormal

hoof conformation consisting of long toe, low heels, and higher medial wall is also thought to contribute to IUFP[3].

Signs and Symptoms: Fixation vs. Intermittent:

UFP can be witnessed by visual observation of the horse in motion. Upon asking the horse to move from a stand still into a walk, one or sometimes both stifles can be locked into an extending position, identified by the animal's inability to protract the leg forward, or flex the limb(s) causing the involved hind leg to drag behind. The horse may hop on three legs, dragging the affected leg behind[4]. When the horse can not unlock the stifle, this is considered upward fixation of the patella. Often the problem may present less severe than that, manifested by a subtle delayed release (intermittent) of the patella which causes the horse to move in a jerky fashion, especially when the horse decelerates[2]. Each time the patella is released, the stifle tends to collapse a little, giving the appearance that the hind leg is buckling at each step. This gait is more pronounced when the horse walks slowly down a slope[5]. This may be also tested by reining the horse back which increases the need for exact coordination of the muscle timing , adding more pressure on the stifle and patello-femoral complex, locking may occur during this maneuver[7].

In long standing or acute cases, joint effusion may be noted locally or just distal to the stifle joint via observation and palpation of the femoropatallar joint. This indicates that there is an intracapsular joint effusion with possible intracapsular joint pathology such as; retropatella, femoral condyle or damaged cartilage surfaces[5]. The medial ligament may be inflamed (desmitis), partially torn or undergoing structural changes due to the forces through the ligament[5]. Manual palpation of the joint and specific ligaments may result in pain responses exhibited by the horse indicating tenderness of the specific ligaments involved. Upon severe cases of UFP, the need for manual unlocking of the patella is indicated, warranting the need for intervention to prevent further joint damage.

Veterinarian Role:

Assessment and Diagnosis:

The veterinarian is usually the first diagnostician involved with a horse suffering from IUFP. Assessment will involve visual observation of the horse's conformation, palpation of joints and limbs for heat, swelling or tenderness, along with observing the animal at movement, looking for visual demonstration of signs and symptoms mentioned above. Differential diagnosis of stringhalt, fibrotic myopathy, ligament desmitis and tendonitis are a few to consider in light of the clinical signs associated with IUFP[1].

Diagnostic Tools:

Diagnostic tests of radiographs, diagnostic ultrasound, along with scintigraphy, and infrared thermography (sometimes unreliable), joint anesthesia/nerve blocks, and stifle arthroscopy can be performed to rule out problems other than IUFP. This wide range of diagnostic tests available to veterinarians are essential in ruling out other conditions

common at the stifle joint such as: osteochondrosis dessicans, bone cyst, patellar fracture, cruciate ligament injury, congenital malformation of the medial condyle and or the patella, ligament sprain, degeneration of articular surfaces, or fracture. Analgesics or anti- inflammatories may be prescribed.

Treatments:

Conditioning:

If the situation of IUFP appears to be a functional deficit resulting from low muscle tone and minimized activity, often physical therapy (PT) and rehabilitation exercise will be prescribed with substantial results[3]. If it does not resolve and is determined to result from more significant structural deformity, rehabilitation methods should still be considered with the understanding that results may be achieved at a slower rate. If these attempts are not successful, several other treatment options exist, which will be discussed below, in order of invasive severity. The following veterinarian interventions are beyond the purpose of this case study.

Injections

Cases that are more persistent and non responsive to conservative treatment can be treated by **injecting counterirritants** into and around the MPL[2]. It is hypothesized that injection could change the shape and size of patellar ligaments resulting from an inflammatory response[3]. Injection of a counterirritant causes a local fibrosis thought to tighten down the medial ligament in hopes of making it more responsive to the dynamic pull of the quadriceps, if ligament laxity was the cause. Less than desirable results have been reported and may not result in a permanent cure. Extreme care must be taken not to inject the irritant into the stifle joints; the inflammation and cartilage damage that results can be severe[5].

Desmotomy

When UFP is not alleviated by improving general fitness and muscle tone or by injecting counter irritants in the and around the MPL then surgical measures are indicated[2]. Transection of the medial patellar ligament is known as **medial patellar desmotomy (MPD)**. Refer to the first schematic drawing for identification of incision site. MPD is recommended when UFP is unresponsive to aforementioned conservative treatment. MPD has been reported to have complications. Patellar stability is compromised in this approach, resulting from poor joint pathomechanics and the development of DJD is probable causing the horse to experience chronic lameness. Studies have shown that MPD may often lead to stifle joint instability, degenerative arthritis and can predispose the patella to fragmentation if work is resumed too soon after surgery. Therefore it is no longer recommended to be the treatment of choice for UFP[2]. However, in cases of UFP, where the stifle is locked into an extended position, MPD may be the only option. Historically relative short periods of rest were prescribed after MPD, varying from 2-6 weeks. Based on results of Dumoulin et al, a longer convalesce period of up to 3 months of stall rest is suggested, with out a guarantee of soundness, in all cases[3].

Precutaneous Splitting

A new procedure utilizing **ultrasound guided precutaneous splitting (USGPCS**) of the MPL has had more favorable result than MPD. The proposed rationale for precutaneous splitting of the proximal third of the MPL is to induce a localized desmitis (ligament trauma) that would result in localized ligament thickening[2]. The horse is placed in a dorsal recumbent position under general anesthesia. The hind limb is placed in full extension under tension. A small incision is made in the area of the MPL while an ultrasonography transducer (UST) is utilized adjacent to the incision site to guide the veterinarian's scalpel for splitting the MPL. Via UST, the surgeon guides the scalpel to the proximal third of the ligament and fenestrates it (also referred to as "tendon splitting") just below its fibrocartilagesoneous attachment to the patella. This treatment is further followed by peri-operative antibiotics for five days but no anitinflamatories. The horse is hand walked the day after surgery for fifteen minutes day three times a day for two weeks, followed by normal activity. In Tnibar's study MPL size increased 2-3 fold during the first four post-operative weeks with stabilization thereafter. None of the patients had clinical signs of the UFP after surgery intervention[2]. Enforced daily exercise was recommended for two weeks after surgery then normal activity was progressively resumed[2]. The decision to have these surgeries performed should not be made without considering the potential complications[5].

Conformational (structural) problems are often more difficult to treat than disuse atrophy problems and often require surgical intervention. The functional problems stem from deconditioning and poor motor control of the quadricep muscles. The weaker the quadriceps, the more ineffective, thus allowing the patella to become caught on the medial condyle of the femur, preventing it from unlocking. The MPL thus becomes stretched out causing further pathomechanics of joint laxity, and problematic erosion of the retro-patellar articular surface. Frequently this sequellae responds favorably to the intervention of physical therapy modalities for pain and swelling relief, promotion of healing of tissue trauma, and retraining of the motor control system via exercise progression intervention. The goal of PT intervention is to prevent further degeneration, to avoid surgical interventions, and to restore the equine back to functional performance.

Role of Physical Therapy**:**

Until recently the conservative treatment for this condition involved unregulated exercise approaches with out specific prescriptive protocols or controlled progression. Many times the horse owner was told, "Work him in straight lines, and up and down hills". This approach for conditioning the horse was haphazard and not well defined. Therefore it was common for horses to become more problematically painful with prolonged stifle dysfunction, thus leading down the road towards injection or surgery. The above mentioned invasive approaches involve risk of infection, pain, swelling, and prolonged recovery time, without guarantee of successful return to function.

Up until two decades ago, there has been a large gap in the rehabilitation options offered to equines and their owners. Not much existed between veterinary medicine, surgerical intervention and home remedies. Slowly the idea of animal rehabilitation and physical therapy has been catching on in the United States. Physical therapy treatment approaches based on the research evidence, has been done primarily on animals in search

of remedies for human ailments. Now these are being considered for animal treatment. Since physical medicine research has been based on animal clinical trials, why not treat the animals with the same treatments we have offered humans in physical therapy for over 100 years?

Physical therapy (PT) is a dynamic profession with an established theoretical and scientific base and widespread clinical applications in the restoration, maintenance, and promotion of optimal physical function[8]. Physical therapists diagnose and manage movement dysfunction and provide interventions to restore optimal physical function. Physical therapy on animals is an emerging profession, representing qualified physical therapists that are using their physical therapy skills on animals[7]. Animals of all disciplines, whether working or domestic pets, get injured, undergo surgery, and have the potential to heal. The most common domestic mammals, dogs, cats, and horses, have similar connective tissue physiology to humans, therefore the same tissue healing principles that are commonly used in human PT can be applied to them.

The role of the newly emerging equine physical therapist is one of a trans-interdisciplinary approach. This would involve the PT working with other disciplines of veterinarian medicine, the horse owner, the trainer, the farrier, and other adjunct practitioners. The common goals of alleviating impairment, reducing disability and improving function are shared by all. Chiropractors, acupuncturist and massage therapist are all approapriate paraprofessionals to be involved in the recovery of injured animals. Many of these approaches can compliment one another in the ideal of total health, returning the equine to full recovery.

Assessment- treatment- rehabilitation for the horse should follow the current human and veterinarian evidence-based practice trends[7]. This not only encompasses both orthopedic and neuromuscular principles but also exercise physiology, biomechanics, and performance enhancement. The use of neuromotor model for rehabilitation is encouraged considering the equine locomotive system in terms of joint stability and mobility[7].

In Part II of this two-part series, an equine case study and treatment protocol will exhibit the expertise the field of PT can offer in equine dysfunction. Stay tuned to the next addition of OPTP for the continuation of IUFP Case Study and Treatment Protocol.

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